*Volume 40* February, 1954 *Number 2*



# Lubrication

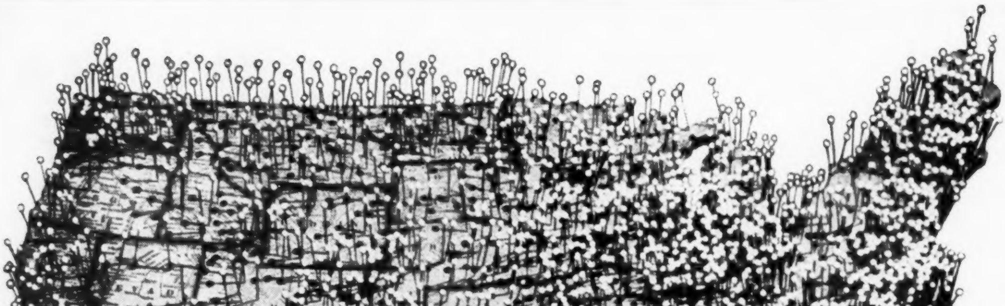
A Technical Publication Devoted to the Selection and Use of Lubricants

THIS ISSUE

RUBBER PROCESSING

TEXACO

PUBLISHED BY
THE TEXAS COMPANY
TEXACO PETROLEUM PRODUCTS



# CALL THE NEAREST "PIN"

Each pin on the map represents a Texaco Distributing Plant. To serve you, wherever you are, there are more than 2,000 of them—in all 48 States.

A call to the nearest "pin" will bring you important help in stepping up your production and bringing down your unit costs.

Made-for-the-job Texaco Lubricants and famous Texaco Lubrication Engineering Service bring these benefits daily to plants in every branch of industry.

Find out what they can do for *you*. No cost, no obligation.

The Texas Company, 135 East 42nd Street, New York 17, N. Y.

TEXACO

**TEXACO Lubricants, Fuels and Lubrication Engineering Service**

# LUBRICATION

A TECHNICAL PUBLICATION DEVOTED TO THE SELECTION AND USE OF LUBRICANTS

Published by

The Texas Company, 135 East 42nd Street, New York 17, N. Y.





Vol. XL February, 1954 No. 2

*Change of Address:* In reporting change of address kindly give both old and new addresses.




# RUBBER PROCESSING

Most of the world's supply of crude rubber comes from the tree known as Hevea Brasiliensis. This tree originated in the Amazon region in South America but in 1876 Sir Henry Wickham took Hevea seeds to London where seedlings were grown. The trees were successfully transplanted in Ceylon and Malaya and now millions of them are growing throughout Ceylon, Malaya, the East Indies, Philippines, and some locations in Africa. Approximately 97% of the crude rubber comes from the South East Asia area and a comparatively small amount, known as para rubber, is produced in South America.

"Wild rubber" also is collected in natural forests by natives, but the amount is not of great importance in normal times.

The only crude rubber produced in Continental U. S. comes from the Guayule shrub but cost of production is considerably higher than for the imported crude.

During World War II, when the supply of crude rubber was curtailed, it was necessary to expand quickly the existing small synthetic rubber industry. In the next two or three years great technical advancements were made and synthetic rubber production replaced almost completely the natural rubber supply. Now that natural rubber is again available synthetic rubber production has been directed largely to uses for which it is better suited than natural rubber.

## NATURAL RUBBER

Approximately half of the South East Asian production comes from large plantations operated by European or American companies. These plantations are run scientifically and trees are improved by grafting. This has resulted in a production increase up to 1000-1500 pounds per acre.

The rest of the crude rubber production in the East comes from small native plantations which are not too efficiently run. The rubber is of lower quality, often contains foreign material, and the production per acre is approximately one-half that of the larger plantations.

### Tapping of Trees

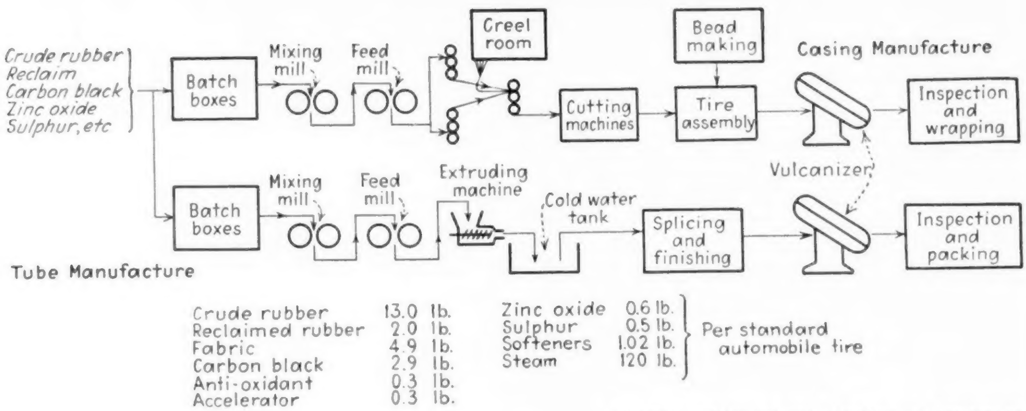
A small channel halfway around the tree is cut in the bark at a 35-degree angle; sometimes two cuts in the form of a "V" are made and the sap or latex is collected in a small cup placed at the lower end. Continual tapping injures the trees so a rest period equal to the tapping period is usually allowed.

The latex as it comes from the tree contains about 35% rubber. Since it coagulates rapidly, it must be taken to the factory for processing as soon as possible. Here it is cut or diluted with water to about 15 or 20% strength for ease in further processing.

### Coagulation

Mild acids are added to latex in pans or tanks to speed the coagulation of rubber. After a few hours, the coagulum is firm enough to be rolled into sheets or slabs. Grooved rollers produce a ribbed effect and water is sprayed during the rolling. The sheets

**RUBBER (Automobile Tire)**




*Courtesy of Chemical and Metallurgical Engineering*

**Figure 1 — Flow Sheet.**

are hung up to drain for several hours and are then placed in a smokehouse to dry. Open wood fires provide a temperature of 100 to 130°F. and after 5 to 12 days the finished sheet is ready for baling and shipping.

Rubber is graded according to the Rubber Manufacturers' Association Standards and placed in one of the categories shown herewith. The color, texture and foreign mineral content are factors which determine grade and price.

| *Grade* | *Use* |
|---|---|
| 1. Ribbed Smoked Sheet | Tires — Inner Tubes, Footwear, Molded Articles. |
| 2. Pale Crepe | Thin Sheet Goods, Translucent Articles. |
| 3. Brown Crepe | Blended with other Grades for Tires. |
| 4. Remilled Blanket Crepe | Tire Treads and Molded Rubber Articles. |
| 5. Para Rubber | Sheeting, Thread, Cements and Cable Insulation. |
| 6. Guayule | Blended with other Grades for Friction Stocks where Tackiness is Desired. |
| 7. Special Grades | Some Grades such as "Sole Crepe" bring premium prices and are used for shoe soles. |

## SYNTHETIC RUBBER

Early in World War II new synthetic rubber plants were designed, built and operated by the petroleum, rubber and chemical industries and were financed largely by the U. S. Government. Fifty-one new plants were put in operation at a cost of 700 million dollars. The success of this program was a tribute to the ingenuity and ability of the cooperating companies. In 1942, approximately 4% of the total rubber used was synthetic; by 1945, the amount had increased to 87%.

The most important synthetic rubbers are GR-S, Neoprene, Butyl and Buna N; in addition, there are several variations of each type. All have properties similar to natural rubber although none are identical to it. Some of these synthetic varieties are superior and some inferior to natural rubber in certain characteristics. Rubber experts can choose the product having best characteristics for the particular use intended. Pertinent data on the four main types of synthetic rubber are shown below:

### GR-S (Government Rubber — Styrene)

This variety is made by co-polymerization of butadiene and styrene which are derivatives of petroleum, alcohol, and coal tar. It was used during the war as a general purpose product to replace natural rubber in tires since its performance characteristics and processing properties were similar to natural rubber. It is somewhat tougher and more difficult to process than natural rubber but research has developed means of overcoming this difficulty. Many variations of GR-S have been made, each with certain valuable characteristics.

### Neoprene

Neoprene is made by polymerization of chloroprene (chlorinated derivative of butadiene). It

was originally developed by E. I. duPont de Nemours & Co. and is still manufactured under their supervision.

Neoprene resists action of oil, sunlight and heat; it is also flame resistant but in other respects it is closer than other synthetics to natural rubber.

## Butyl Rubber

This rubber is made by co-polymerization of isobutylene and isoprene. Both are derivatives of petroleum.

Butyl rubber is different chemically from other synthetic products and natural rubber. It is not compatible with natural rubber and should not be blended with it.

It has several outstanding characteristics such as low permeability to gases and it is chemically resistant to weather, sunlight, oxygen, and various solvents, fatty oils and acids.

Butyl rubber is used chiefly for inner tubes, cements, adhesives and linings for equipment handling corrosive liquids.

## Buna N (GR-A, Government Rubber Acrylonitrile)

Buna N consists of a copolymer of butadiene and acrylonitrile.

This type of rubber is very resistant to oil, gasoline and aromatic solvents. It is tougher than natural rubber and more difficult to process. It blends easily with natural rubber and other synthetic rubbers.

Buna N, because of its resistance to the deteriorating effect of fuels, can be used as lining of bulletproof gasoline tanks.

## Manufacture of Synthetic Rubber

Each of the above synthetic rubbers is manufactured in a different way from a variety of ingredients. The procedure in most cases is quite complicated. As an example, the following outline shows briefly some of the steps required in making GR-S—(Government Rubber-Styrene):—

1 — One of the ingredients, Butadiene, is a colorless gas derived from either petroleum or alcohol.

The other ingredient, Styrene, is an oily liquid derived from either petroleum or coal tar.

2 — Approximately 71 parts of Butadiene and 29 parts of Styrene are blended with an emulsifying agent and copolymerized with the aid of a catalyst.

3 — The reaction takes place at about 125°F. and requires about 15 hours.

4 — Inhibitors are required to stop the reaction at the correct time to produce GR-S of suitable characteristics.

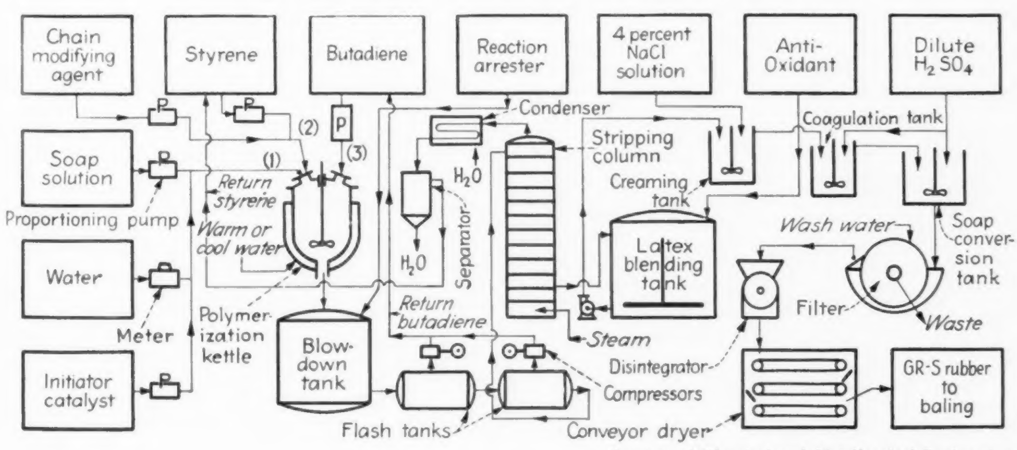
5 — Steam distillation removes the unreacted material and the latex is coagulated by addition of certain chemicals. The latex is then separated, dried and packed into bales.

# RECLAIMED RUBBER

Scrap vulcanized rubber from tires, inner tubes, boots, shoes, etc., is reprocessed by mechanical, thermal and chemical treatment to produce many useful rubber articles.

Reclaimed rubber has several advantages including low cost, easier processing and good aging characteristics.

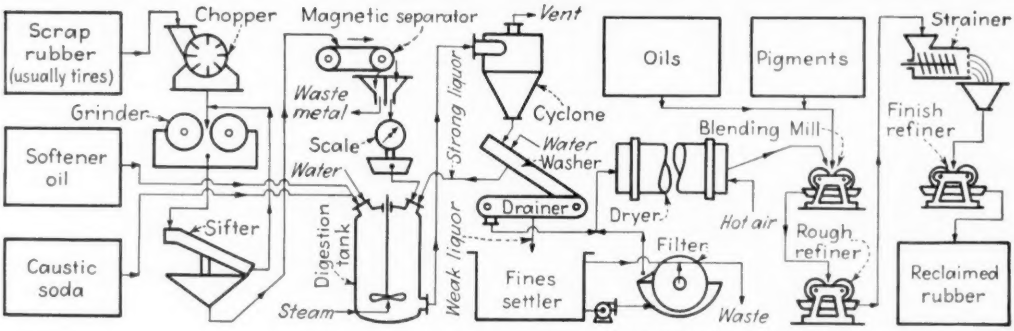
**BUNA S (GR-S) SYNTHETIC RUBBER**




*Courtesy of Chemical and Metallurgical Engineering*

**Figure 2 — Flow Sheet.**

RUBBER RECLAIMING




Courtesy of Chemical and Metallurgical Engineering

Figure 3 — Flow Sheet.

The first step in reclaiming rubber is to remove all metal parts. Then it is ground up to a fineness of $\frac{1}{8}$" to 1/30" and given one of the following treatments:

1. *Alkali Digestion* — Scrap is heated with caustic soda solution which removes fabric. The treatment also softens the rubber and makes it easier to process further.
2. *Acid Digestion* — Some processors use sulfuric acid treatment to remove fabric and then give additional alkali treatment.
3. *Pan Process* — Scrap free from fabric is mixed with oil and caustic soda and heated with live steam.
4. *Mechanical Process* — For some purposes scrap is merely ground up to a 30 mesh and used for blending in small quantities with new rubber.

In any of the above processes involving acid or alkali treatment, the scrap must be thoroughly washed with water to remove last chemical traces. The scrap must then be dried before further processing.

The subsequent refinement of reclaimed rubber is carried out on mills with rolls set closely together. The sheets produced are forced through a fine strainer to remove any additional metal and the material is rolled further to remove solid unsoftened particles. The stock is then rolled into slabs.

Reclaimed rubber can be blended with natural or synthetic rubber to make articles such as tires, footwear, heels and soles, battery cases, inner tubes, cements, wire insulation, and mats.

## PROCESSING OF GENERAL RUBBER GOODS

Processing of rubber compounds involves not only incorporation of the proper amounts of ingredients but also the development of characteristics which will enable the compound to be easily handled and to provide desirable qualities in the finished product.

In order to process crude, synthetic or reclaimed rubber into condition suitable for use, it must be put through several processes such as:

1. Breakdown
2. Mixing
3. Calendering
4. Extruding
5. Preparation for Curing
6. Vulcanizing

A brief description of each of these processes is shown below and lubrication of the various types of machinery involved will be discussed.

## BREAKDOWN

Rubber in the crude state has a comparatively hard consistency and is difficult to handle. Consequently it is necessary to break down its structure or to soften it to a point where subsequent processing is facilitated. Another purpose of breakdown is to blend chunks of rubber from different batches to produce a more uniform product.

### *Gordon Plasticator*

The Gordon Plasticator is often used for breaking down either crude or synthetic rubber. This is really a large extrusion machine which can handle considerable quantities at one time. One pass-through usually produces the desired plasticity. This machine consists essentially of a specially-designed rotor or screw enclosed in a cylinder equipped with a suitable extruding head. It is also provided with equipment for heating or cooling various parts. Drive is by electric motor through reduction gears which are fully enclosed and which run in an oil bath.

### *Lubrication of the Gordon Plasticator*

The main parts of the plasticator to be lubricated

are roller bearings, a thrust bearing, and reduction gears. Bearing housings are designed to include adequate seals which will prevent leakage of the lubricant.

The thrust bearing is a very important part of this machine. Heavy thrust loads are absorbed here when the stock is extruded, so the proper type of lubricant assists the bearing in taking up this load. This bearing, along with the adjacent rotor bearing, has an independent lubricating system.

The lubricant used for this service is quite heavy, having a viscosity of 140 to 165 seconds (SSU) at 210°F. The manufacturer recommends a compounded oil which, due to its fatty oil content, is intended to provide increased adhesiveness to the oil film, permitting heavy loads and giving low bearing wear. The parts operate continually in a bath of this oil.

The reduction gears which are a part of the plasticator drive are fully enclosed and run in a bath of lubricant providing splash application. The gears are heavy duty type and they are lubricated usually with a straight mineral oil with viscosity of 350 to 600 SSU at 210°F. Under severe operating conditions, however, a mild EP lead soap type lubricant with similar viscosity is specified in order to provide a greater factor of safety to the lubricating film.

Breakdown of crude rubber also can be accomplished in the rubber mill and even more effectively in the Banbury mixer.

## MIXING

After rubber stock has been broken down the next step is to mix it with all the ingredients that are necessary to produce a satisfactory final product. The sequence in which the ingredients are mixed in the batch is often important to the quality of the final blend. The following order has been found suitable:

1 — Rubber
2 — Plasticizers and softeners
3 — Accelerators and anti-oxidants
4 — Fillers, including pigments for color
5 — Sulfur (for vulcanizing)

Proper mixing provides uniform blending of the ingredients throughout the rubber. Two types of machines can be used for this process, the rubber mill and the Banbury mixer.

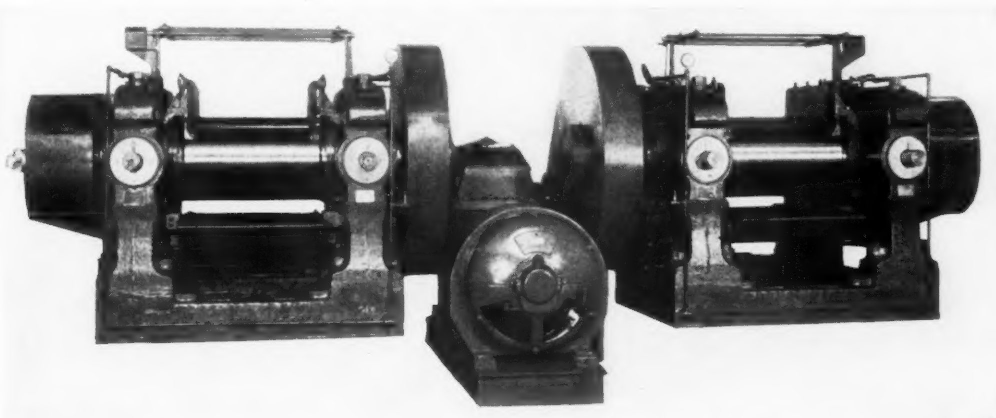
### Rubber Mills

Mills are used for many purposes such as breaking down, grinding rubber and scrap materials and warming stock in preparation for the calender and tubing machines. Mills still are used for mixing rubber and compounding ingredients but to a lesser extent since the Banbury mixer came into such universal use.

Mixing in a mill requires skilled handling. Broken rubber is applied to the mill and the various ingredients are added in proper order. The blend has to be continually folded and rolled to get the ingredients evenly dispersed. This method is slow and hard to control and it is gradually being displaced by the Banbury mixer.

*Lubrication of Rubber Mills*

Mills operate at slow speeds and under heavy pressures. Accordingly the lubricants used for gears and bearings must be of heavy body and adapted to take shock loads. For lubrication of sleeve type roll bearings, manufacturers specify oils ranging in viscosity from 100 to 300 SSU at 210°F. (depending on the size of equipment and temperature of operation). Under certain adverse conditions com-



*Courtesy of Erie Engine and Manufacturing Co.*

**Figure 4 — Twin 60" Mills with Right Angle Drive.**

pounded or mild EP Oils are recommended to provide proper lubrication. For gears and pinions, straight mineral oils ranging in viscosity at 210° F. from 100 to 1500 SSU are required, depending on the type of gears involved. Mild EP Oils containing lead soap are also suggested to handle some of the severe operating conditions.

"Crackers", "Washers" and "Refiners" are similar to ordinary rubber mills but they vary as to size of rolls, finish of roll surfaces, speed and other characteristics. The rolls are shorter in relation to diameter and in crackers and washers one or both of the rolls are corrugated. Refiner rolls are ground smooth and are of different diameters to increase surface speed differential. In refiners the rolls are run close together under heavy pressure and at much higher speed to obtain greatest possible refining action.

## Banbury Mixers

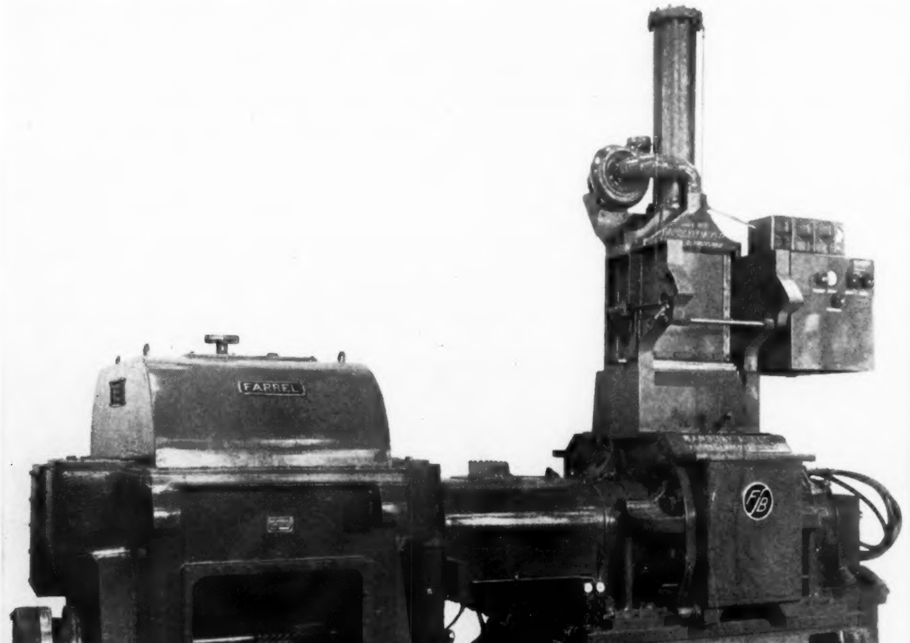
In modern mills the mixing of ingredients is done in Banbury mixers, which provide a much faster method of blending and greater uniformity between batches.

The Banbury mixer is of very rugged construction because of the heavy duty work it must perform. The machine consists essentially of an enclosed trough or mixing chamber in which operate two mixing rotors or blades, a hopper into which materials are fed and a sliding-door in the bottom through which the mixed batch is discharged. The blades of the rotors are formed in an interrupted spiral and the rotors are operated at slightly different speeds to apply a smearing action between component particles. Water sprays are installed around the body of the machine for cooling. The rotors also have cooling elements. End-thrust adjustments are provided to absorb the slight axial forces developed by the spiral blades and to prevent stock from working out through the housings. These adjustments are designed for close fitting and follow-up as wear occurs.

A two-speed motor is optional so that the machine can be operated not only at standard speed but at a somewhat higher speed where desirable. The temperature of working is controlled by the amount of cooling water which is circulated through the cored rotors and sprayed against the side wall.

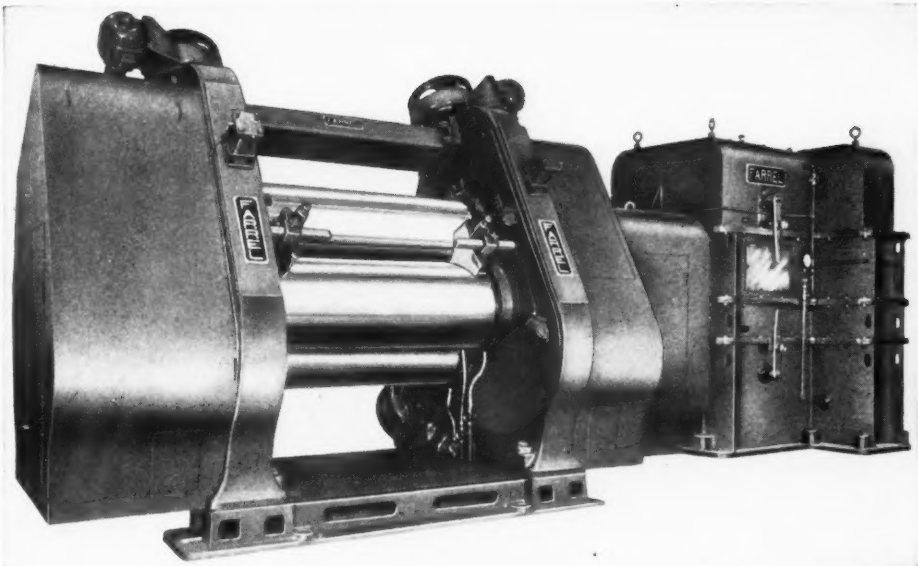
*Lubrication Requirements for Banbury Mixers*

Some of the older mixers were designed for a top




*Courtesy of Farrel Birmingham Co., Inc.*

**Figure 5 — Size 11 Banbury Mixer with Uni-Drive.**



*Courtesy of Farrel Birmingham Co., Inc.*

**Figure 6 — 24" x 68" Tri-Angular Calender with Unidrive.**

horsepower of 250 at 20 rpm. but the newer machines develop horsepower of 800 at 40 rpm. The latter are capable of handling heavier loads resulting from mixing tougher stocks at higher speeds. The new type machines have been improved and they now consist of 3 distinct sections, as follows:

1 — Gears which were formerly mounted on the rotors are now enclosed, with the primary reduction gears in a separate housing. Gears and bearings are lubricated automatically. Mild EP Gear Lubricants (leaded type) are usually used. (Viscosity at 100°F. SSU around 3000).

2 — Universal spindles connect the drive with the Banbury rotors and power is transmitted to each individually. These are lubricated with adhesive type greases of NLGI Grades 1 or 2.

3 — The Banbury mixer itself has been strengthened and new, harder materials are used for the working elements to withstand the more intensive work of mixing the stiffer stocks coming into use. The main bearings, thrust collars and discharge door rails are lubricated with a heavy duty type EP Grease of NLGI No. 1 Grade by means of a force feed grease system.

## CALENDERING

Calendering is an operation in which plastic rubber is rolled into flat continuous sheets or is pressed into fabric by passing between large steel rolls.

Heat is necessary to maintain the plasticity of the rubber, consequently the rolls are steam heated. Considerable pressure is also exerted on the bearings and it is usually necessary to cool them with water to prevent bearing metal from softening.

Many problems arise in this operation, such as scorching of the sheeting, sticking, tearing, blistering or roughness. Compounders and operators must be able to recognize and correct the adverse conditions causing these difficulties.

*Lubrication Requirements for Calenders*

Some of the calender rolls are equipped with precision roller bearings while others have plain sleeve type bronze bearings. Older types of calender bearings are lubricated by compression grease cups, grease pockets in the top bearing caps or by heavy oil. Modern calenders provide for automatic lubrication of the bearings through either a mechanical force feed lubricator, or flood lubrication of the journal boxes with a circulating pump, oil cooler, filter and reservoir.

The viscosity of the oil required for calender bearings depends upon the journal temperature. Up to 140°F. an oil of 75-125 seconds SSU Viscosity at 210°F. is suggested. Above this temperature heavier oils with maximum viscosity of 330 seconds at 210° F. are required. For grease lubricated bearings, a heavy duty grease that has been compounded with a fairly high viscosity mineral oil is acceptable.

Gears and pinions of calenders require straight mineral oils with viscosities of 100 to 1500 SSU at 210° F. The choice depends on the type of gears involved. Mild EP Oils are also used to take care of some of the more severe operating conditions.

Manufacturers' lubrication guides should be fol-

lowed for lubrication of various parts of these machines.

## EXTRUDING

Extrusion is a continuous process for converting uncured rubber stock into long strips of specific cross section, such as rods, tubes, sheets or filaments. Extrusion machines are usually of the screw type in which warm rubber stock is fed into the mouth and forced into the head and out through the die.

Like calendering, this process requires operators with skill and knowledge in order to meet the numerous problems that may arise. Rate of feed, speed of machine, temperature, plasticity of the rubber stock and presence of dirt are factors that influence the quality and quantity of product delivered by the machine.

Natural Rubber, GR-S and Neoprene usually extrude more smoothly than Butyl or Buna N types.

*Lubrication Requirements for Extrusion Machines*

Heavy pressure is necessary for forcing rubber stock through the die. Consequently the gears, bearings and especially the thrust bearing, are heavily loaded. The use of the proper type of lubricant will minimize wear on the parts and will promote smooth operation of the equipment.

The following types of lubricants are usually specified for various parts of the extruder:

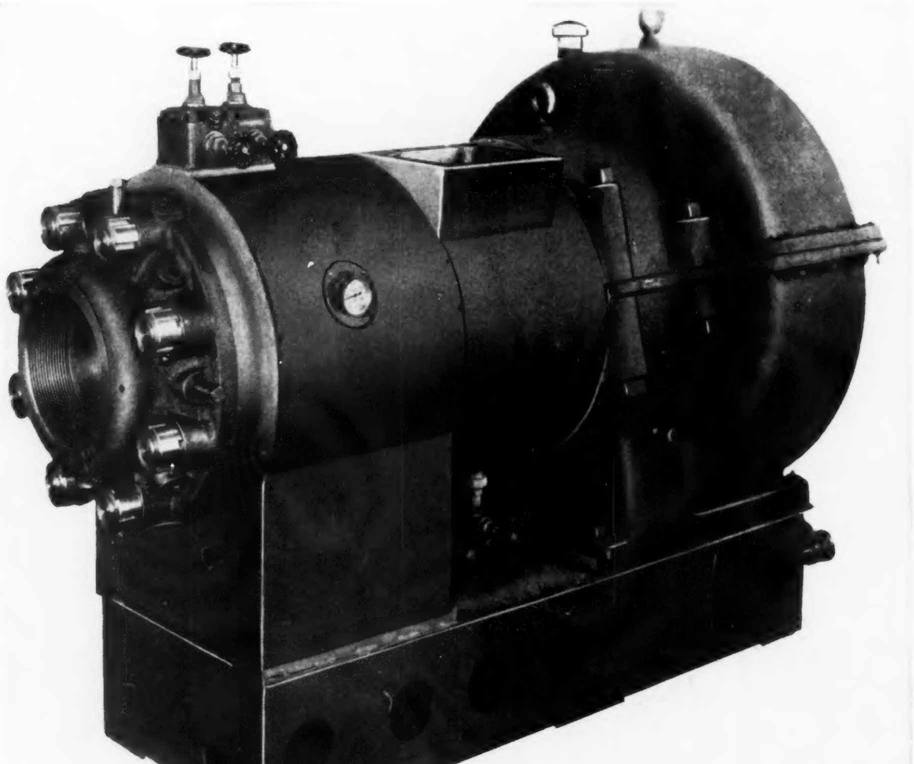
For the main screw radial and thrust bearings, enclosed drive gears and bearings (lubricated by splash or circulating system), feed roller gears and bearings (bath lubricated) a mild type EP lubricant of 90 to 170 SSU viscosity at 210° F. should be employed. High grade heavy bodied steam cylinder type oils of similar viscosity also can be used.

Motor sleeve bearings require a high grade oil of 275 to 325 SSU viscosity at 100° F.

All anti-friction bearings can be lubricated with a heavy duty grease of No. 2 NLGI grade.

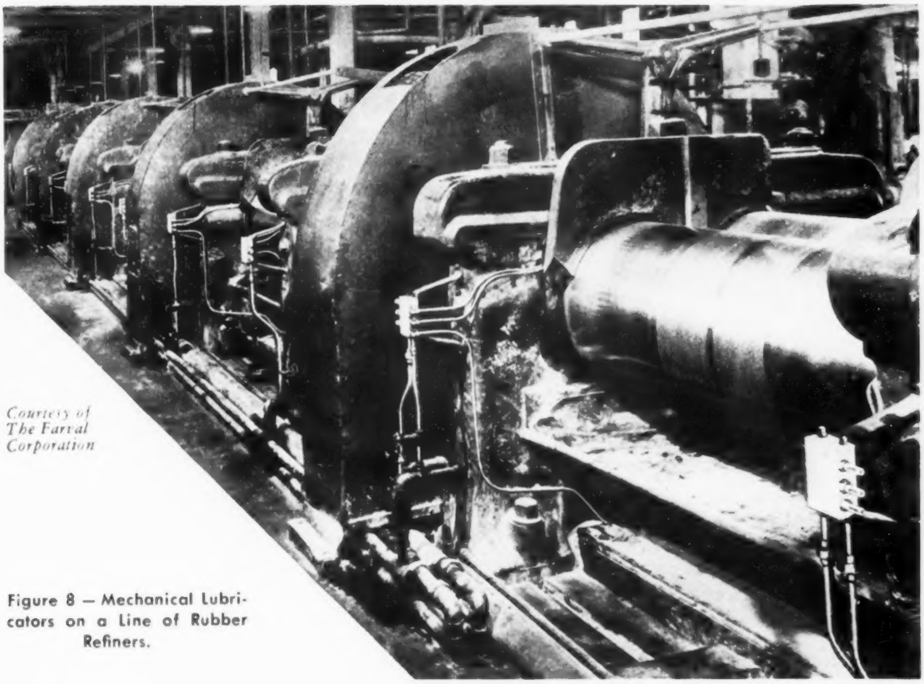
## PREPARATION FOR CURING

The preparation of rubber stock for vulcanizing is comparatively simple for some articles and con-



*Courtesy of National Rubber Machinery Co.*

**Figure 7 — Model 8-50 NRM 8" Heavy Duty Extruder.**



*Courtesy of The Farval Corporation*

**Figure 8 — Mechanical Lubricators on a Line of Rubber Refiners.**

sists merely of cutting up proper sized pieces for the molds.

Preparation is very complex for other articles, such as automobile tires. A great deal of hand work is required for building up the various compounds and component parts necessary to produce a satisfactory tire.

## Vulcanizing

Prior to 1839, rubber was used as a waterproofing material but it was too sticky and unstable to be of great commercial value. In that year, however, Charles Goodyear discovered that the incorporation of sulfur in rubber and subsequent heating or curing would produce a non-tacky, hard, elastic and stable material suitable for many uses. It can be said truly that in that year the foundation of the modern rubber industry was established.

Sulfur is still the principal vulcanizing agent for natural rubber. It is also used with synthetic rubbers, with the exception of Neoprene, for which zinc oxide or magnesium oxide are used. Fine yellow powdered sulfur, about 99.9% pure, is used. The amount of sulfur required varies from 0.5 to 4%, depending on the type of rubber. As a general rule natural rubber requires half again as much sulfur as synthetic.

Other vulcanizing compounds, such as the following, are sometimes used to give desirable characteristics to the finished rubber:

Methyl Tuads (complex organic compound containing 13% available sulfur)

Methyl Selenac and Ethyl Selenac (contain both sulfur and selenium)

Vandex (powdered selenium)

Telex (powdered telurium)

Zinc Oxide and Magnesium Oxide (for Neoprene)

## Other Materials for Compounding

In addition to vulcanizing agents many other types of additives may be incorporated in the rubber compounds to produce characteristics desired in the particular object being manufactured. A few of these are shown below:

Abrasives
Accelerators of Vulcanization
Accelerator Activators
Accelerator Retarders
Anti-oxidants
Anti-Softeners
Blowing Agents
Fillers for Re-inforcing
Fillers — Inert
Fungicides
Odorants
Pigments and Coloring Agents
Plasticizers
Stiffeners
Sun-check Inhibitors

## Curing

After the rubber articles have been prepared in the final desired shapes it is necessary to complete the vulcanizing process usually by application of heat in one form or other. Thin articles can be cured at high temperatures in 3 to 5 minutes. Thick articles may require lower temperature and longer time to give uniform curing throughout. The following methods are used:

Press Cure—All molded goods are cured under pressure. Tiles, mats and belting also are pressed between metal strips.

Dry Heat Cure—Footwear, rubber fabric and clothing usually are cured by dry heat.

Steam Cure—Live steam is used to cure insulated wire, tubular goods and hose.

Hot Water Cure—Some special types of rubber products are cured in a hot water bath.

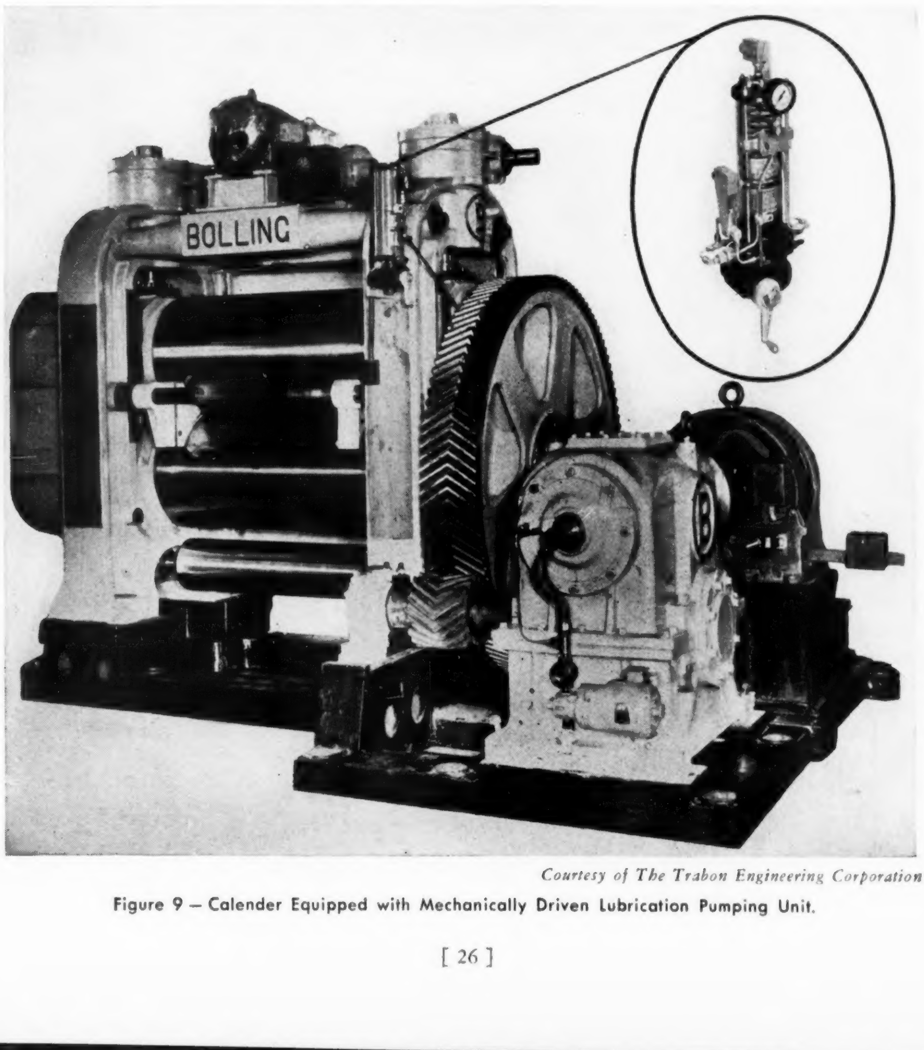
Room Temperature Cure—By use of special accelerators some articles can be cured at room temperatures.

## HEAVY DUTY SERVICE

Most of the machinery used in processing rubber is very rugged and is designed for heavy duty service. Rubber is of such consistency that it resists being worked and great power is necessary to break it down to the required plasticity for subsequent operations.

Heavy Duty bearings in the rubber industry may be of the plain sleeve type or they may be roller bearings. In the Banbury mixer, for example, plain bearings are used to carry the journals on the rotors. These bearings have to be protected by dust stops which prevent leakage of ingredients into the bearings.

On the plasticator, roller bearings carry the rotor. Calenders, mills and other roll machines usually employ sleeve bearings. The type of bearing used in these machines has been developed by the builders on the basis of their experience in actual operations.




*Courtesy of The Trabon Engineering Corporation*

**Figure 9 — Calender Equipped with Mechanically Driven Lubrication Pumping Unit.**

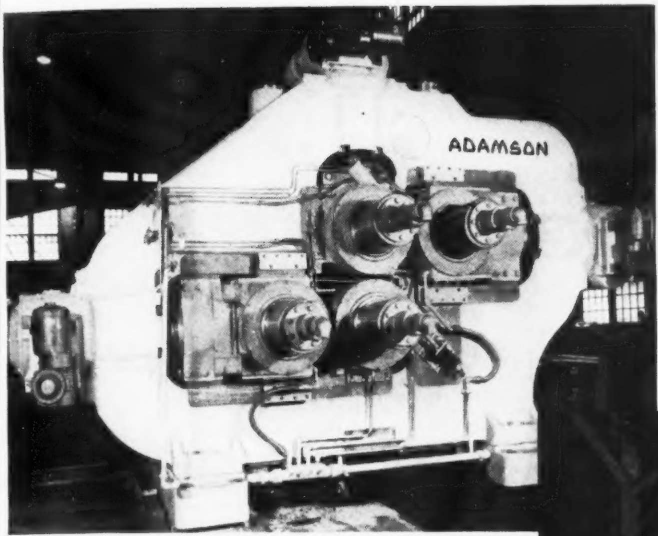
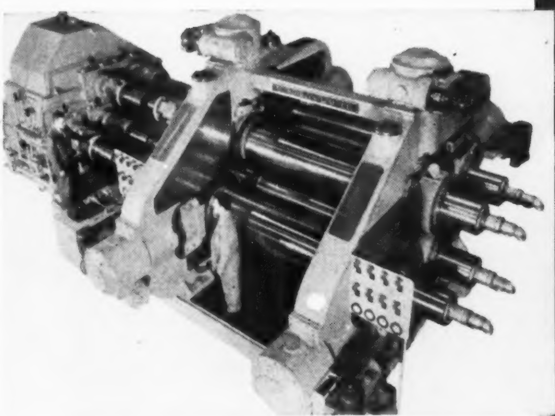
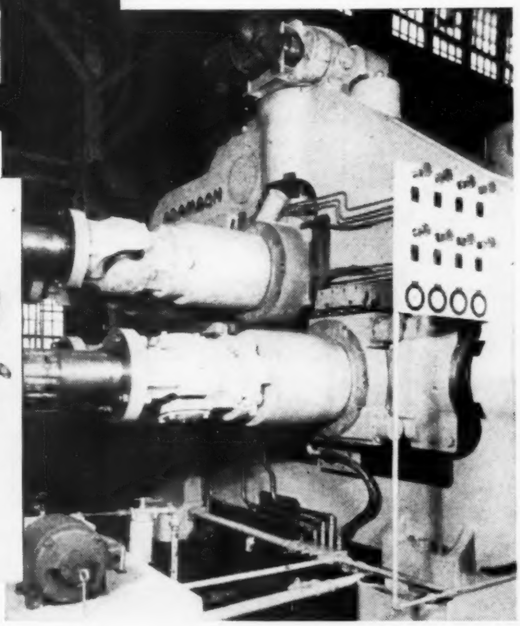



Figure 10 — Views of a Four Roll Z-type Calender, showing separate Pinion Stand Drive, Main and Pullback Bearings, and Lubrication Lines.

*Courtesy of Adamson United Co.*





## Plain Bearing Lubrication

Several methods are used for lubrication of plain bearings. Oil cups, splash or bath lubrication, grease cups or centralized grease lubrication are applicable to rubber mill machinery. Centralized grease lubrication under controlled pressure is gaining more prominence since it prevents the possibility of abrasive material getting in with the grease and assures regular lubrication.

Regular attention to the lubrication schedule is very important and all operators should be drilled with this thought in mind. Great care must be taken to see that centralized systems are kept filled with clean grease and that the splash or bath oiled bearings are regularly supplied with adequate amounts of clean oil.

## Roller Bearing Lubrication

In roller bearing service the lubricant performs a four-fold duty, viz:

1. It protects the surfaces of the bearing elements against corrosion.

2. It assists the seal in preventing water or dirt from coming into actual contact with the bearing surfaces.

3. It serves as a conductor of heat to aid in bearing cooling.

4. It functions as a lubricant to facilitate free rolling of the rollers and sliding action between the rubbing surfaces of the shoulders and rollers.

A "free flowing" lubricant at the prevailing operating temperatures will lead most nearly to the attainment of these objectives. By this term is meant a grease or oil which will "train" readily with the rollers, yet channel sufficiently so that actual churning does not occur. Excessive churning will build

up the torque through internal resistances within the lubricant itself. This frictional effect leads to heat development which may easily build up the bearing temperature beyond the cooling ability of the lubricant, at times even beyond the cooling ability of the external cooling system.

In roller bearing lubrication it is very important to keep abrasive foreign material from entering the bearing during service and it is equally important to use clean, dirt-free lubricants. Abrasive particles in a grease will cause rough rolling of the bearing. Eventually chattering will develop and excessive heat in the bearing will assist in lubrication breakdown due to oxidation. This may lead ultimately to failure requiring bearing replacement.

Pressure grease lubrication of heavy duty roller bearings has several advantages such as exclusion of foreign matter, economy of lubricant, minimum hazard in handling and filling, and remote control.

Roller bearings designed for oil lubrication must be provided with specially prepared seals which keep out contaminating materials and keep the oil in. Bearings can be supplied with measured amounts of oil or can be provided with oil circulation.

## Extreme Pressure Lubricants

Higher speeds and heavier loads on machines have contributed to a trend towards use of EP lubricants for rubber machinery gears and certain bearings. Before the advent of EP gear lubricants bull gears were lubricated with straight mineral oil. In order to take care of continuous shock loads, however, it has been found advantageous to use a mild type of EP gear lubricant. Such products usually consist of high quality straight mineral oils blended with lead soaps and other EP materials to produce compounds of good adhesiveness and pronounced stability.

In addition to load-carrying capacity this type of lubricant should have other outstanding characteristics:

1—*Performance*

It should not lose its extreme pressure characteristics during service.

2—*Non-Separation*

It must not separate in storage or in service and it should be centrifuged without loss of lead soap. Laboratory tests equivalent to 40 passes through a mill centrifuge should show no loss in lead compound.

3—*Exceptional Adhesive Properties*

It should be adhesive to gears even if submerged in water.

4—*Non-Corrosive*

It should be non-corrosive to steel, copper, bronze or cadmium-nickel bearings.

5—*Good Miscibility*

Any heavier grades can be cut back with a lighter grade of the same type of oil if lower viscosity is desired for low temperature service. Mixing should be done around 150°F. outside of the lubricating system to obtain a completely uniform product.

## Hydraulic Oils

In processing rubber and other plastic materials hydraulically operated equipment is used quite extensively. Petroleum type oils are used almost exclusively as the hydraulic media in these applications.

Severe operating conditions are often encountered in these systems involving heat, water contamination and rust formation. For that reason it has been necessary to develop high quality oils that would combat these conditions.

The better types of hydraulic oils today are highly refined and contain certain additives that provide the following outstanding advantages:

1. They provide long life of lubricant by minimizing the oxidation or sludge forming tendencies.

2. They prevent rust formation in hydraulic systems. Small amounts of rust can cause damage to pumps and reduce greatly their efficiency.

3. They suppress the natural foaming tendency of an oil when air leaks into a system. Excessive foaming may give faulty machine operation and will cause more rapid oxidation of the hydraulic oil.

Although the premium quality hydraulic oils may be initially more costly than the ordinary type they are more economical in the long run because they will provide long and trouble free operation.

## Processing Oils

In addition to petroleum products used in lubrication of rubber handling machinery, sizeable quantities of petroleum oils and waxes are also used as ingredients in compounding. These oils and waxes impart softness, flexibility or tackiness qualities desired in certain types of rubber products.

# CONCLUSIONS

Rubber manufacture is one of our essential industries today and it is becoming increasingly important in our present era of mechanized living.

The lubrication of heavy duty rubber mill machinery has required high quality lubricants which petroleum research has made available.

In addition to contributing to the lubrication of processing machinery the petroleum refiners are also proud of the role they have been privileged to play in the manufacture of synthetic rubber. This contribution has been of vital importance to our military operations and continues to be to our civilian requirements.



Printed in U. S. A. by
Salley & Collins Inc
305 East 45th Street
New York 17, N. Y.